Orthopaedics & Traumatology: Surgery & Research 101 (2015) 247–249

Available online at ScienceDirect www.sciencedirect.com

Elsevier Masson France EM|consulte www.em-consulte.com/en

Technical note

Femoral lengthening during hip resurfacing arthroplasty: A new surgical procedure

L. Vasseur[a,b,*], B. Ayoub[a,b], P. Mesnil[a], G. Pasquier[a,c], H. Migaud[a,b], J. Girard[a,b,d]

[a] Université de Lille, 59000 Lille, France
[b] Service d'orthopédie C, hôpital Salengro, CHU de Lille, place de Verdun, 59000 Lille, France
[c] Service d'orthopédie D, hôpital Salengro, CHU de Lille, place de Verdun, 59000 Lille, France
[d] Département de médecine du sport, faculté de médecine de Lille, université de Lille 2, Lille, France

ARTICLE INFO

Article history:
Received 11 June 2014
Accepted 2 December 2014

Keywords:
Lengthening
Leg length discrepancy
Hip resurfacing
Femoral osteotomy
Hip prosthesis

ABSTRACT

Correction of leg length discrepancy during hip arthroplasty is a technical challenge. Although resurfacing proposed to young subjects presents a number of advantages (stability, bone stock, etc.), it does not correct leg length discrepancy. We propose an original femoral lengthening technique concomitant to resurfacing performed through the same approach, consisting in a Z-shaped subtrochanteric osteotomy. Resurfacing was performed first and the femoral and acetabular reaming material was used for autografting. The series comprised five cases followed for a mean 42.2 months (range, 33–64 months). The mean surgical time was 100 min (range, 76–124 min). Weightbearing was authorized in all cases at the 8th week. The mean lengthening was 32 mm (range, 25–40 mm). Healing was observed in all cases. This surgical technique, reserved for very young subjects who accept an 8-week postoperative period without weightbearing, can be proposed in cases with substantial preoperative leg length discrepancy.

1. Introduction

Management of preoperative leg length discrepancy during total hip arthroplasty (THA) is usually planned preoperatively [1,2]. In young patients, leg length discrepancy frequently results from sequelae of childhood diseases (osteochondritis, congenital dislocation, etc.). In these same patients, hip resurfacing seems to be an attractive alternative to conventional THA given the following advantages: preservation of bone stock [3], absence of instability [4], return to a high level of activity, better proprioception [5,6], and possible return to sports activities [7,8].

Preoperative leg length discrepancy up to 2 cm can easily be managed during conventional THA [3] with no additional procedures. In hip resurfacing, the leg can be lengthened by a maximum 1 cm as long as the procedure has been rigorously planned, but greater lengthening is impossible without an additional procedure, one of the limitations of this concept [3].

The objective of this study was to present a femoral lengthening technique performed contemporaneously with hip resurfacing in cases of leg length discrepancy and to describe the preliminary results. This technique combines the advantages of hip resurfacing in young patients with leg lengthening greater than 1 cm by means of a Z-shaped osteotomy with plate fixation based on the technique reported by Cauchoix et al. [9] after hip resurfacing.

2. Surgical technique

The intervention was conducted through the posterolateral approach lengthened distally in laminar flow conditions with the patient in the lateral decubitus position. It began with conventionally conducted resurfacing: posterior dissection in two planes (pelvitrochanteric and joint capsule), followed by arthrotomy in two bands (inferior and superior) [10]. The femur was prepared first and then, depending on the implant diameter retained, the acetabular cup was impacted, preserving the acetabular and femoral reaming products. Femoral lengthening was then performed using an oscillating saw in the subtrochanteric area in a Z-shaped cut according to Cauchoix et al. [9]. The amount of lengthening projected was identical to the length of discrepancy on X-rays, with a 5-mm difference tolerated. The preoperative planning required that the length of the longitudinal osteotomy line be twice as long as the lengthening targeted to ensure sufficient contact between bone fragments (Fig. 1): for a 3-cm lengthening, a 6-cm longitudinal line was required. The transversal proximal osteotomy line was made 2 cm under the lesser trochanter on the lateral femoral side so that at least two screws could be placed above

* Corresponding author. Tel.: +03 20 44 68 28; fax: +03 20 44 66 07.
E-mail address: vasseurlaurent@ymail.com (L. Vasseur).

http://dx.doi.org/10.1016/j.otsr.2014.12.014
1877-0568/

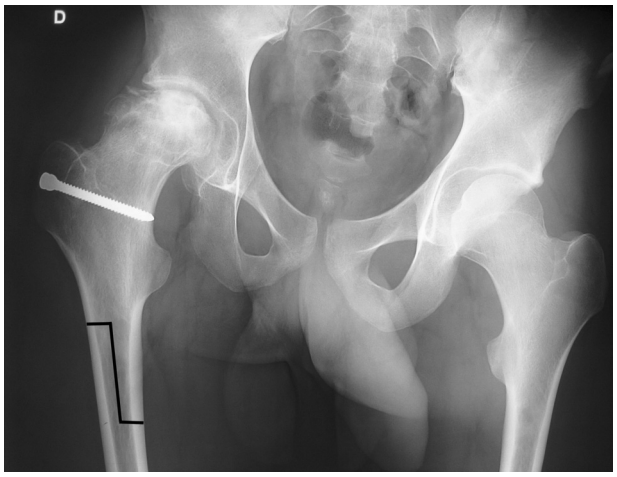

Fig. 1. Preoperative planning of the femoral osteotomy. It should be located approximately 2 cm under the lesser trochanter and measure twice the planned length along the longitudinal axis. A screw neutralizing the two fragments was added to stiffen the assembly.

the osteotomy. This line was purposely sufficiently proximal for better healing in the metaphyseal-diaphyseal area. The longitudinal cut was made first and then the transversal osteotomy cuts were made. The femur was lengthened using gentle traction in the diaphyseal axis, with the fragments maintained by Verbrugge clamps. Metallic wire cerclages temporarily stabilized the assembly. The osteotomy was then fixed using an AO DCP 4.5 plate, which was applied to the lateral side of the femur with three non-locking screws under the site and two non-locking screws above. The osteotomy sites were grafted with the femur and acetabula reaming product. The patient was required not to apply weight to the operated leg for 8 weeks, with thromboembolic event prevention using low-molecular-weight heparin. Hip mobilization was resumed immediately after surgery.

The results were assessed at 6, 12, and 25 weeks postoperative and then every year. The Merle d'Aubigné (PMA) [11], Harris Hip [12], and Oxford [13] scores were calculated. Leg length discrepancy was evaluated on AP pelvic X-rays by the vertical distance separating the line linking the two lesser trochanters at their bases to the tear drop line [14]. After surgery, lengthening was evaluated by measuring the distance between the proximal and distal points of the osteotomy and corrected according to the diameter of the prosthetic femoral head. Compensated and uncompensated blood loss was estimated according to Mercuriali and Inghilleri [15].

The series comprised five males with a mean age of 25.8 years (range, 21–32 years) last seen at a mean follow-up of 42.2 months (range, 33–64 months). The patients' mean height was 162 cm (range, 151–173 cm) and mean body mass index was 19.6 kg (range, 16.6–21.1 kg). The initial etiology was juvenile osteochondritis of the hip for all five patients. Three patients had a history of past surgeries: one childhood femoral varus osteotomy, one shelf acetabuloplasty, and one Ganz approach with trochanterotomy.

3. Results

The mean surgical time was 100 min (range, 76–124 min). The mean intraoperative blood loss was 510 mL (range, 320–630 mL) and the mean postoperative blood loss was 320 mL (range, 250–500 mL). No transfusions were required. The clinical and radiological preoperative leg length discrepancy was 30 mm (range, 20–40 mm) and 34 mm (range, 25–40 mm), respectively. The mean lengthening achieved was 31 mm (range, 25–40 mm). At the last radiological follow-up, the residual leg length discrepancy was 3 mm (range, 0–6 mm).

All the patients resumed weightbearing at the end of the 8th postoperative week. The preoperative Harris and PMA scores increased from 33.2 points (range, 22–49 points) and 7 (range, 5–9 points), respectively, to 89.2 points (range, 81–100 points) and 16.2 (range, 14–18 points) at follow-up. The preoperative Oxford score decreased from 42.8 points (range, 39–52 points) to 22.2 points (range, 12–35 points) at the follow-up. No non-union was observed at the last follow-up (Fig. 2). Three patients had the plate removed at 20, 25, and 26 months (Fig. 3).

4. Discussion

Few articles have investigated the management of substantial preoperative leg length discrepancy during the THA procedure other than arthroplasties in patients with congenital hip dislocations [16,17]. Our surgical technique indicates that lengthening contemporaneous with hip resurfacing is possible, but it requires

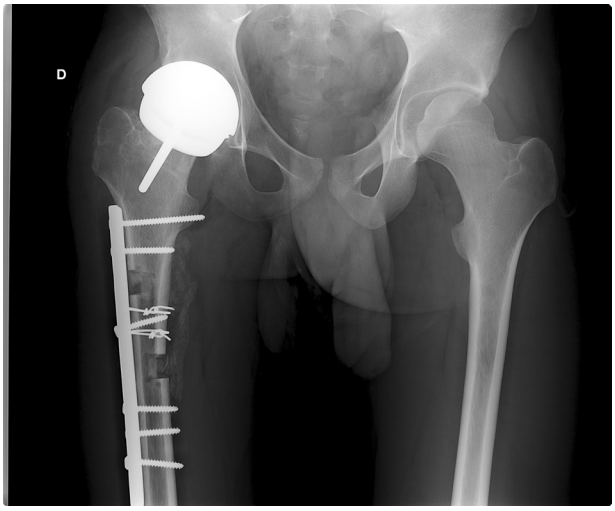

Fig. 2. X-ray 3 months after surgery. Union is occurring at the osteotomy sites.

Fig. 3. AP X-ray after material removal. The femoral morphology is considered normal with a rectilinear femoral shaft (which will allow a stem to be inserted with no particular complications in case revision surgery is needed).

an 8-week off-loading and autologous grafting material. We believe that this technique should be reserved for primary or secondary osteoarthritis of the hip in young subjects with preoperative leg length discrepancy greater than 10 mm.

Preoperative planning is determinant in performing calculated, well-controlled lengthening, without which lower limbs with equal length may not be obtained [18]. For this purpose, use of the EOS system improves presurgical measurements [19]. Our clinical results at follow-up are comparable to the results obtained with conventional THA [20]. However, this method presents several limitations:

- a long period without weightbearing that the patient must be informed of when consent is obtained;
- a longer incision length than in conventional arthroplasty and the need to remove material at a later date: these features must be weighed against simpler and more rapid postoperative recovery in conventional arthroplasty;
- finally, intraoperative bleeding is greater than during isolated resurfacing (390 mL) or THA (419 mL) [21], but without reaching the threshold over which transfusion is needed.

On the other hand, we observed no cases of non-union in this short series, which nevertheless remains a potential risk [22], as does a secondary fracture at the osteotomy site [23]. We emphasize the need for autograft associated with durable osteosynthesis to prevent these complications. Of the 20 proximal femoral derotation osteotomies associated with hip resurfacing in neurological patients, Prosser et al. [24] reported three cases of disassembly and two fractures, all occurring in the group that had no autologous grafting material.

5. Conclusion

Femoral lengthening osteotomy contemporaneous with hip resurfacing makes lengthening the lower limb more than 2 cm possible while preserving the advantages of the hip resurfacing concept. It is preferable to reserve this technique for young and active patients who may better tolerate 8-week postoperative non-weightbearing than older subjects. In this small series of five cases, there were no greater complications than those encountered with hip resurfacing provided that certain technical rules are followed: stable osteosynthesis associated with cancellous autografting and no weightbearing for 8 weeks after the procedure.

Disclosure of interest

L. Vasseur, B. Ayoub and P. Mesnil declare that they have no conflicts of interest concerning this article.

G. Pasquier is an educational and research consultant for Zimmer.

H. Migaud is an educational and research consultant for Zimmer and Tornier.

J. Girard is an educational and research consultant for Microport and Smith and Nephew.

References

[1] Woolson ST, Hartford JM, Sawyer A. Results of a method of leg-length equalization for patients undergoing primary total hip replacement. J Arthroplasty 1999;14:159–64.
[2] Desai AS, Connors L, Board TN. Functional and radiological evaluation of a simple intra operative technique to avoid limb length discrepancy in total hip arthroplasty. Hip Int 2011;21:192–8.
[3] Girard J, Lavigne M, Vendittoli PA, Migaud H. Hip resurfacing: current state of knowledge. Rev Chir Orthop 2008;94:715–30.
[4] Krantz N, Miletic B, Migaud H, Girard J. Hip resurfacing in patients under thirty years old: an attractive option for young and active patients. Int Orthop 2012;36:1789–94.
[5] Jiang Y, Zhang K, Die J, Shi Z, Zhao H, Wang K. A systematic review of modern metal-on-metal total hip resurfacing vs standard total hip arthroplasty in active young patients. J Arthroplasty 2011;26:419–26.
[6] Szymanski C, Thouvarecq R, Dujardin F, Migaud H, Maynou C, Girard J. Functional performance after hip resurfacing or total hip replacement: a comparative assessment with non-operated subjects. Orthop Traumatol Surg Res 2012;98:1–7.
[7] Fouilleron N, Wavreille G, Endjah N, Girard J. Running activity after hip resurfacing arthroplasty: a prospective study. Am J Sports Med 2012;40:889–94.
[8] Lavigne M, Masse V, Girard J, Roy AG, Vendittoli PA. Return to sport after hip resurfacing or total hip arthroplasty: a randomized study. Rev Chir Orthop 2008;94:361–7.
[9] Cauchoix J, Morel G, Rey JC, Cotrel Y, Ghosez JP. Single-stage lengthening of the femur. Record of the 1st 100 surgical cases. Rev Chir Orthop 1972;8:753–74.
[10] Girard J. Resurfaçage de hanche. EMC Techniques chirurgicales, Orthopédie-Traumatologie 2013;8:1–9 [A 44-660].
[11] Merle D'Aubigne R. Cotation chiffrée de la fonction de la hanche. Rev Chir Orthop 1970;56:481–2.
[12] Harris WH. Traumatic arthritis of the hip after dislocation and acetabular fractures: treatment by mold arthroplasty. An end-result study using a new method of result evaluation. J Bone Joint Surg Am 1969;51:737–55.
[13] Delaunay C, Epinette JA, Dawson J, Murray D, Jolles BM. Cross-cultural adaptations of the Oxford-12 HIP score to the French speaking population. Orthop Traumatol Surg Res 2009;95:89–99.
[14] Pierchon F, Migaud H, Duquennoy A, Fontaine C. Radiologic evaluation of the rotation center of the hip. Rev Chir Orthop 1993;79:281–4.
[15] Mercuriali F, Inghilleri G. Proposal of an algorithm to help the choice of the best transfusion strategy. Curr Med Res Opin 1996;13:465–78.
[16] Fujishiro T, Nishiyama T, Hayashi S, Kurosaka M, Kanno T, Masuda T. Leg length change in total hip arthroplasty with subtrochanteric femoral shortening osteotomy for Crowe type IV developmental hip dysplasia. J Arthroplasty 2012;27:1019–22.
[17] Rogers BA, Garbedian S, Kuchinad RA, Backstein D, Safir O, Gross AE. Total hip arthroplasty for adult hip dysplasia. J Bone Joint Surg Am 2012;94:1809–21.
[18] Tripuraneni KR, Archibeck MJ, Junick DW, Carothers JT, White RE. Common errors in the execution of preoperative templating for primary total hip arthroplasty. J Arthroplasty 2011;26:980–1.
[19] Guenoun B, Zadegan F, Aim F, Hannouche D, Nizard R. Reliability of a new method for lower-extremity measurements based on stereoradiographic three-dimensional reconstruction. Orthop Traumatol Surg Res 2012;98:506–13.
[20] Leclercq S, Lavigne M, Girard J, Chiron P, Vendittoli PA. Durom hip resurfacing system: retrospective study of 644 cases with an average follow-up of 34 months. Orthop Traumatol Surg Res 2013;99:273–9.
[21] Chiron P, Murgier J, Reina N. Reduced blood loss with ligation of medial circumflex pedicle during total hip arthroplasty with minimally invasive posterior approach. Orthop Traumatol Surg Res 2014;100:237–8.
[22] Cauchoix J, Morel G. One stage femoral lengthening. Clin Orthop Relat Res 1978;136:66–73.
[23] Morel G, Servant J, Valle A, Jegou D, Teillet J. Extemporaneous femoral lengthening by the Cauchoix technic in children and adolescents. Rev Chir Orthop 1983;69:195–200.
[24] Prosser GH, Shears E, O'Hara JN. Hip resurfacing with femoral osteotomy for painful subluxed or dislocated hips in patients with cerebral palsy. J Bone Joint Surg Br 2012;94:483–7.